

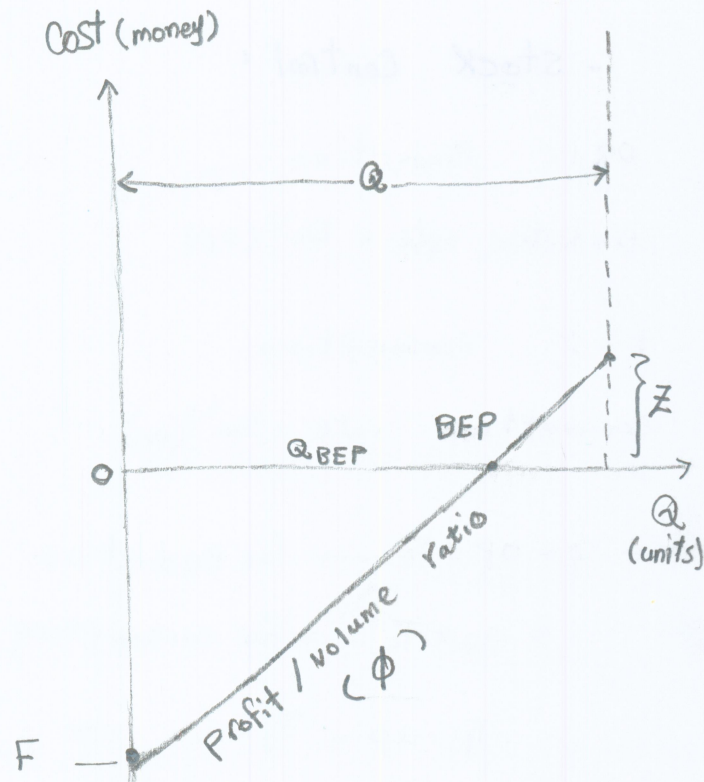
* Profit - volume chart

Given : Z (Profit)

Q (Volume)

F (Fixed Cost)

$$\phi = \frac{F}{Q_{BEP}} = \frac{F + Z}{Q}$$

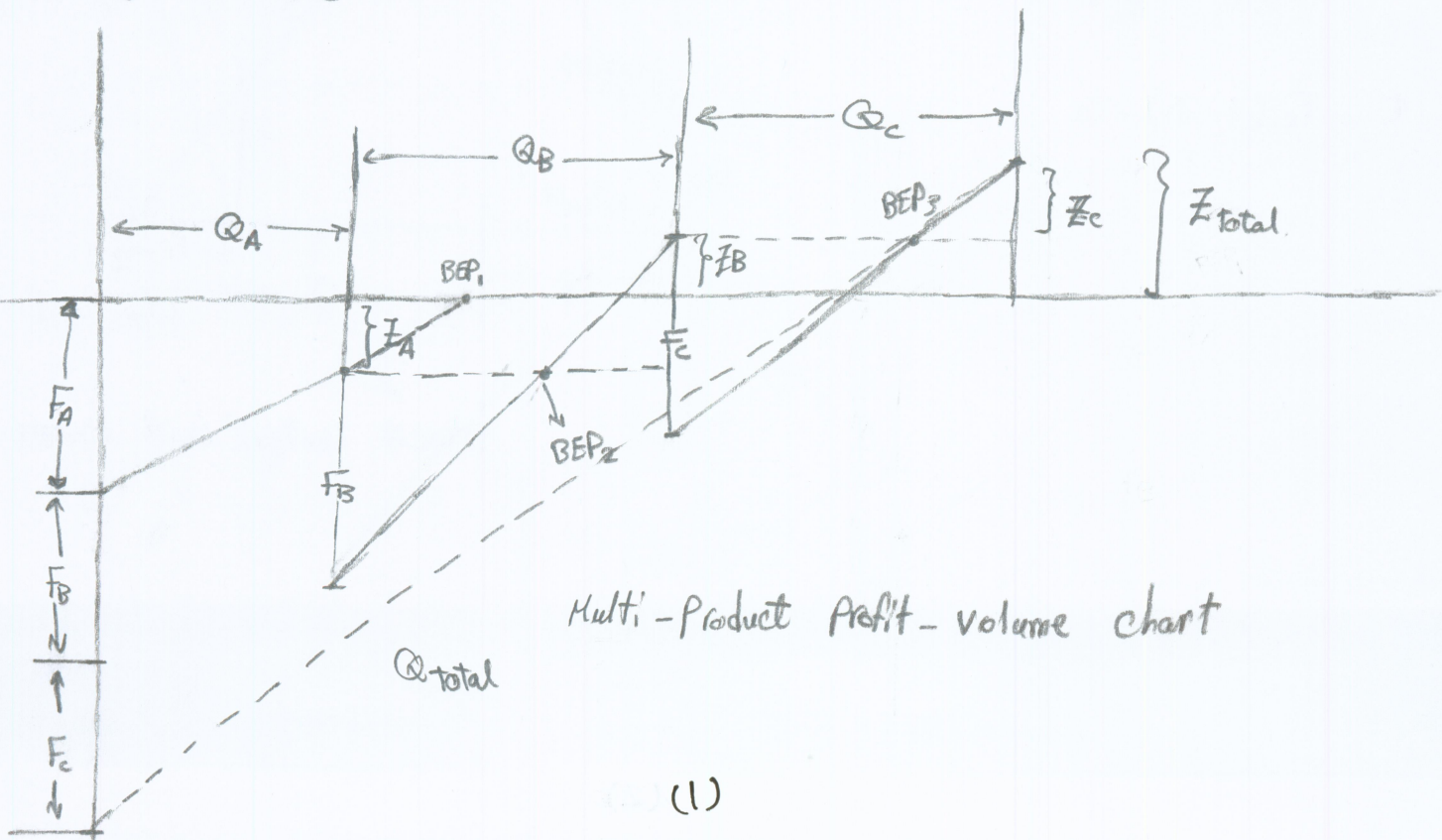


- Multi-products profit/volume chart :

$A \rightarrow Q_A, F_A, Z_A$

$B \rightarrow Q_B, F_B, Z_B$

$C \rightarrow Q_C, F_C, Z_C$



Multi-Product Profit-volume chart

Minimum Cost analysis : (Quantities in Batch Production)

- stock control :

0 : 1 Production

Production rate = $\tan^{-1}(a_p)$

1 : 2 Consumption

Consumption rate = $\tan^{-1}(a_c)$

$$\begin{aligned} \therefore Q &= a_p \cdot T_p \rightarrow \text{for Production} \\ &= a_c \cdot T_c \rightarrow \text{for Consumption} \end{aligned}$$

$$T_p \cdot a_p = T_c \cdot a_c \Rightarrow \frac{T_p}{T_c} = \frac{a_c}{a_p} = \delta \quad (\text{measure of spent time for one prod. cycle})$$

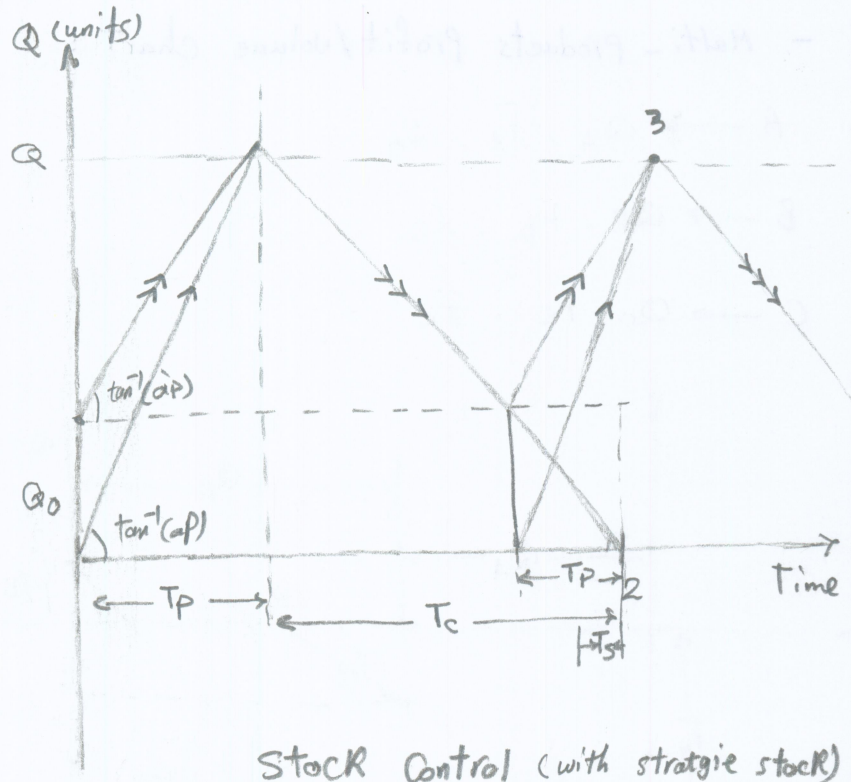
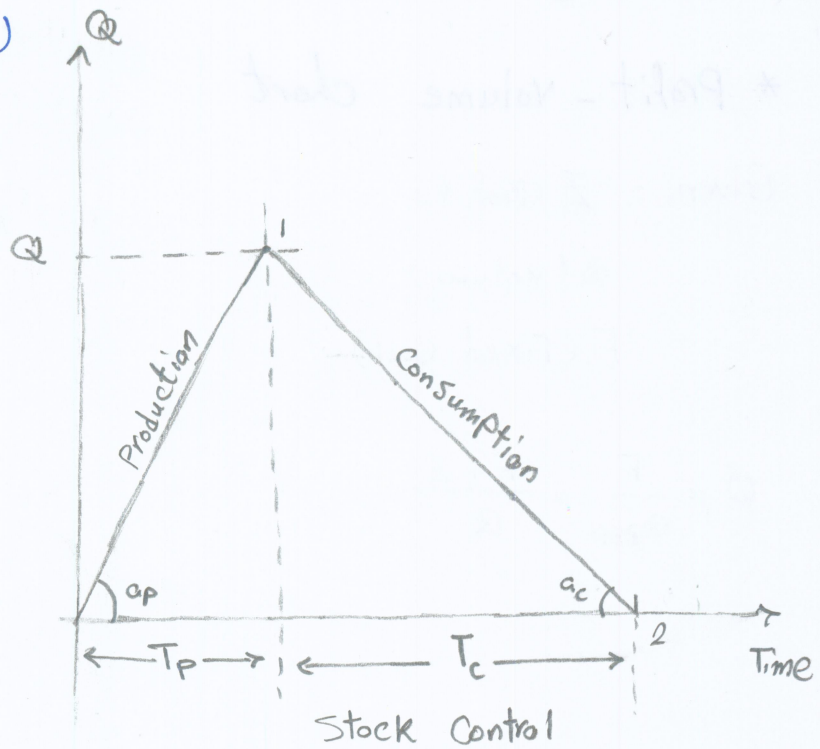
$$\text{If } \delta = 1 \Rightarrow a_p = a_c$$

$$= 0 \Rightarrow \text{no time}$$

$$T = T_c - T_p - t_s$$

$$= T_c \left(1 - \frac{T_p}{T_c}\right) - t_s$$

$$t = T_c(1 - \delta) - t_s$$



Stock Control (with strategic stock)

Minimum-Cost Batch size:

* Batch-Size $\xrightarrow{\text{at}}$ Minimum Cost

* what are the factors affecting the selection of Batch size?

- set-up Cost
- Consumption rate
- Production rate
- Interest Charges per piece per unit time
- Average storage Costs
- Sale Price

* The following four criteria:

- Min. Costs / Piece
- " Profit for the Batch
- Max ratio of profit to Prod. Costs
- Max rate of return/unit time.

* The Production costs per piece consist mainly of four factors:

- Constant Cost per Piece: $C = m + o + l$
 $\begin{array}{l} \downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow \\ \text{material Cost / piece} \quad \text{over-head cost / piece} \quad \text{labor cost / piece} \end{array}$

- Preparation Costs per Piece: $\frac{S}{Q}$
(setting-up)

- Interest carrying costs: $I = i \cdot C \rightarrow \text{constant costs}$
 \downarrow interest rate

$$\text{Interest Carrying Cost / Piece / unit time} = \frac{i}{2a_c} (Q + Q_0)$$

$$\text{For average quantity} = Q_{\text{avg}} = Q_m = \frac{Q + Q_0}{2}$$

$$I = i \cdot Q_{\text{avg}} \cdot T_c = I \frac{Q + Q_0}{2} \cdot \frac{Q}{Q_c}$$

- Storage Carrying Cost / Piece / unit time = $B T_c$
 $= B \cdot \frac{Q}{ac}$

- Production Cost / Piece

$$Y = C + \frac{S}{Q} + \frac{QI}{2ac}(1+\delta) + 2B \frac{Q}{2ac}$$

$$= C + \frac{S}{Q} + \frac{Q}{2ac} [I(1+\delta) + 2B]$$

$$Y = C + \frac{S}{Q} + RQ$$

where $R = \frac{1}{2ac} [I(1+\delta) + 2B]$

at min cost / piece : $\frac{dY}{dQ} = 0$

$$\frac{dY}{dQ} = 0 = 0 - \frac{S}{Q^2} + R$$

$$\frac{S}{Q^2} = R \Rightarrow Q_m^2 = \frac{S}{R}$$

$$Q_m = \sqrt{\frac{S}{R}} \rightarrow \frac{S}{Q_m} = RQ_m$$

$$Y_m = C + \frac{S}{Q_m} + RQ_m$$

$$= C + \frac{2S}{Q_m}$$

$$= C + 2RQ_m$$

